

Some properties and applications of the Green's function for Floquet-periodic domains

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Computing retransmission and reflection of an oblique plane wave impinging on an infinite periodic region is a well-known first step in predicting the response of a frequency selective surface. We consider how to exploit a formalism that supports response prediction, as well as yielding information about an unknown array from the response, the inverse problem. One general analysis technique uses a source-type domain integral equation, leading to consideration of the Green's function for a Floquet-periodic domain. This Green's function corresponds to the field produced by an infinite-periodic phased array of point current elements, one such element per period, with phase changing by a constant increment from each period to the next. It also corresponds to the point-current response within a finite-width domain, with a boundary condition at the opposing surfaces that ties the field values with a phase-increment relationship. This Green's function may be applied to a region of inhomogeneous penetrable material, providing a relationship between internal fields, local material constants, and a corresponding radiation problem due to an equivalent current distribution. A straightforward linear transfer-function of the equivalent current distribution produces the complex reflection and transmission for an arbitrary incoming wave.

Computation of near-field patterns from equivalent current sources appears to require  $(NM)^2$  operations where  $N$  is the total discretization rank in the transverse directions, and  $M$  is the total discretization of the cell in its finite dimension. In the limit of a large number of discrete transverse domain elements, this may be reduced to  $M^2 N \log N$  by utilizing fast Fourier transforms in the transverse directions. We show how this advantage may be exploited in the analysis problem (filling the system matrix), analysis of solution sensitivity, and a cost-function Frechet derivative that constitutes an element of a versatile optimization technique. Applying such inverse problem techniques to Floquet-periodic domains may lead to insights in crystallography, characterization of patterned structures on planetary surfaces, and improved optimization for frequency selective surface designs.

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2. B
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